



WETLAND DEGRADATION AND LOSS DUE TO THE EXPANSION OF ANTHROPOGENIC ACTIVITIES

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ABSTRACT

A wetland ecosystem covers about 5-10% of the earth's land. Wetlands play a significant role in the world's economy but they suffer from several threats from various influencing factors. Wetlands are destroyed due to the expansion of human activities and their effect on living and non-living organisms. Some of India's and Gujarat's wetlands case studies highlight the worst conditions of wetlands from past decades. These case studies highlight the reasons for wetland degradation, and also which types of issues need to be addressed. Wetlands are the most important ecosystem on earth, and to control wetland degradation, it is essential to improve special laws and regulations and be aware of people to conserve ecosystems.

Keywords: Wetlands, Degradation and loss, Ecosystem, Service, Habitat, Urbanization, Economy, destruction.

INTRODUCTION

A wetland is an ecosystem that is constant or recurrent shallow inundation at or near the surface of the ground and the presence of physical, chemical and biological features. The most common characteristics of wetland ecosystems are hydric soil and hydrophytic vegetation. Some specific physiochemical, biotic and anthropogenic factors have harmed those wetlands' features for purpose of development. (Council, 1995)

Wetland ecosystem has unique and high levels of biodiversity, not only obligate organisms but also many terrestrial and marine organisms are indirectly connected with wetland productivity, fresh water and nursery habitats. The Wetland ecosystem has boosted nutrient cycling, improved water quality and carbon sequestration and maintained environment composition also provides food, fiber and controlled flooding. (R. T. Kingsford *et al.*, 2016)

Wetland ecosystem services are uniquely related to hydrological processes that's why wetlands are important for humankind. Wetlands are natural assets but their services are nearly always non-remarkable. Because wetlands generate services that play a major role in human welfare, they are considered a form of wealth. (Daily, 1997; Daily *et al.*, 2000; Development & Institute, 2001; Pagiola *et al.*, 2004; MEa, 2005; Barbier, 2007).

As Freeman states that "The economic value of resources, and ecosystems resides in the contributes that the wetland ecosystem functions and services make to humans well-being." (Freeman III, 2003). Similarly, Boyd and Banzhof state that "wetland ecosystem services are components of nature directly enjoyed, benefits or used for human well-being." (Boyd & Banzhaf, 2007).

Wetland ecosystems are given more benefits to humans which are classified into 3 categories: (1) "Goods"- products provided by ecosystems, such as resource harvest, water and other fuel material; (2) "Services"- recreational, tourism, some ecological regulations and habitat functions like water purification, climate regulations, erosion control and habitat provision; (3) "Cultural benefits"- such as heritage values, spiritual and religious benefits. (*Wetlands as Natural Assets*, n.d.)



The wetland ecosystem occurs in almost every landscape. Wetlands are the earth's most productive ecosystem and are also important for many plants and animal species. Especially migratory birds. Wetlands also provide a habitat for fresh water and marine organisms and they are essential for many bird species as breeding sites and staging areas for nesting during migration. (Naiman & Décamps, 1990).

Wetlands help to decrease the concentration of atmospheric particles and increase the air standard. Environment particular matter (PM) is defined as a mixture of solid and liquid organic and inorganic materials in the air. Wetlands block dust and filter harmful particles in urban areas. They improve the relative humidity and reduce the air temperature, thereby, increasing the mass of the PM. At that time the plants of wetlands absorb environmental particles and decrease the amount of atmospheric PM. Wetlands decrease the amount of PM_{2.5} by 6% (from 50 to 47 $\mu\text{g}/\text{m}^3$) when air quality is good and reduces strongly polluted air by 44% (from 155 to 89 $\mu\text{g}/\text{m}^3$). (Cong *et al.*, 2018).

WETLAND DEGRADATION

Wetlands are the most important ecosystems on the earth, but the rapid growth in human population worldwide caused major wetland destruction. Wetland degradation or loss is due to pollution, wetland reclamation, land use change and civilization and that's why they affect directly human health, biodiversity, regional climate and ecological security. (Bai *et al.*, 2013)

About 5-10% of the earth is covered by wetlands but >70% is already destroyed. Wetlands degradation has some major threats like habitat loss and degradation, invasive species, overharvesting and disease. The serious impact of habitat loss and degradation caused by upstream water resource developments on agriculture, industry and urban development. (R. T. Kingsford *et al.*, 2016)

Globally more people live in urban areas than in rural areas, about 54% of the world's population lived in urban areas. Erratic and unplanned development of the urban area has damaged the environment. Unplanned structures reduce the green cover and emissions of industries and vehicles have caused many climatic issues. (Gupta *et al.*, 2019)

Wetland degradation has created some problems including the extinction of wild flora and fauna, loss of water reservoirs, and loss of natural soil, nutrients and their important benefits. Wetland loss also has effect traditional occupations, cultural activities, food storages, increased drainage and cultivation, and collection of sedges and reeds for roofing and housing. (Bezabih & Mosissa, 2017)

The total water area of the earth and the land integrity showed reducing threats and the wetland has degraded, which directly affects water supply and climate change. The main reason for wetland degradation is becoming transformation of natural wetlands into agricultural land and constructed wetlands. About 49% of flooded wetlands are converted into manmade surfaces or bare land. (Xu *et al.*, 2019)

• **Issues of wetland conservation:**

(1) **Poor management system and mechanism:** The classification of land is based on its components and its management by the government (Y. Chen & Zhou, 2007; Aqsiq, 2007), but the wetland ecosystem is not considered as any type of land. Wetlands are unused land and wild land, there for several wetlands are destructed also the lack of coordination in the mechanism of management agencies has resulted in difficulties in the protection of wetlands.

(2) **Not specific laws and regulations for wetland conservation:** There is no special law for wetland conservation and management due to the lack of a legal framework. Wetlands are not protected as specific land. Wetlands are classified as wild land and this land is used for urban construction which resulted in the rapid degradation of wetlands.

(3) **The negative impact of water conservation projects:** The construction of water reservoir projects directly affects the regional climate, hydrology, sediment deposition, river morphology, biological diversity and water quality. These projects impact the degradation of the wetland ecosystem and destruct the structure and function of the wetland. (Goodchild, 2013)



(4) Inadequate public awareness, education and funding: Sometimes developed regions people are not aware of the importance of wetlands and also people don't have knowledge about wetlands. So the local government have to pay more attention to educating people about wetland conservation. Some industries are discharging their wastewater, and in some areas, residents discharge their rubbish and domestic sewage randomly into wetlands which leads to damage wetland ecosystem. For that, some reasons spreading awareness among people is most important and this work is done when sufficient funds are available.

(Meng *et al.*, 2017)

• **Reasons for wetland degradation:**

The major factors that affect the wetland and destruct them are two types: Anthropogenic factors- (pollution, excessive utilization of biological resources, peat exploration, reclamation, aquaculture, urbanization); and Natural factors- (climate change and biological resources).

(1) Climate change: Climate strongly impacts wetland degradation, mainly change temperature and precipitation. Precipitates increase the water content in soil and enlarge the air of wetlands. (Melly *et al.*, 2017) when the climate will change and the temperature is rise evaporation level is high which results in wetland reduction.

(2) Pollution: The main pollution of wetlands is wastewater discharges from industry, agriculture, animal dung and aquaculture. A large amount of industrial wastewater and domestic sewage is discharged into wetlands, rivers, lakes and swamps. Also, pollution from pesticides and fertilizers caused threats on wetlands which results in degradation. (Act, 2016)

(3) Excessive utilization of biological resources: Wetland ecosystem can provide food, water and shelter for living beings, but excessive utilization of resources has damaged wetlands, and urbanizations and construction are the main threats that caused biodiversity losses. Long-term overgrazing damage soil structure and that damaged soil structure turns into wetland degradation. (Fu *et al.*, 2006)

(4) Urbanization: Many wetlands are changed into artificial aquaculture ponds. Wetlands are occupied by farmlands and infrastructure. Excessive urbanization become very common which leads to the reduction of wetlands and habitat loss of wildlife. The improvement of human activities has turned into a serious lack of wetlands land fragmentation, and a lack of ecological resources is affected by a decrease in the capacity of flood storage and also fish spawning, bird habitat and feeding area destruction. (M. Chen *et al.*, 2016)

(5) Wetland destruction and habitat degradation: Wetland destruction usually turns in the degradation of its ecological functions, and damage the energy flow and nutrient cycling. Human activities caused wetland degradation and wild animals and plants lose their natural habitat. (Yang *et al.*, 2016)

(Meng *et al.*, 2017)

Case study

• **Case study in India:** In India, the total area of the wetland is considered about 11.69 m.ha. This is about 3.66% of the geographic area of the country.

(1) Keoladeo National Park: This national park covers an area of about 29 sq. km on the extreme western edge of the Gangetic basin, a confluence of Gambhir and Banganga rivers in Bharatpur district, Rajasthan. (Perennou & Ramesh, 1987) KNP has a variety of habitats. In the last two decades, major threats are water scarcity and drought conditions, other problems are restricted flow of water in the catchment area, exposure of pollutants and differential inflow of agrochemicals to wetlands in the catchment. (Mathur *et al.*, 2009) One of the major problems in KNP is an uncontrolled growth rate of grass in the wetland area and this may turn into a loss of natural habitat. Wetland management is very important, for a regular survey and collecting information about diversity that helps to identify the condition of wetlands. ("Assessment of Environmental Factors Causing Wetland Degradation, Using Fuzzy Analytic Network Process," 2015)



(2) **Chatra Wetland:** This wetland is located in eastern India, West Bengal. Also, this wetland is known as the peri-urban wetland of English Bazar city because it is located in the southwest corner of the city. Wetland covered an area of about 8.47 sq. km. this wetland provides several ecological benefits to the urban residents. (Pal & Ziaul, 2017). Due to the rapid expansion and urbanization of English Bazar city, it started to convert the wetland of Chatra into other land use. (Kar & Pal, 2012; Pal & Ziaul, 2017; Kar, 2018; Dutta & Sengupta, 2015). In this wetland, rainfall is the main source of water and the area is divided into two parts, one is marshy and the other belongs to the visible surface water area. (Pal & Ziaul, 2017) And the total area of this wetland is shrinking day by day due to urbanization and the demand for cheap land. English Bazar city is unplanned and does not have any proper land use planning, so it will grow in an uncontrolled manner using the land of wetland. It is important to take action against excessive urbanization. (Das & Basu, 2020)

(3) **Varthur Wetland:** Varthur wetland is one of the largest wetlands located south of Bengaluru. The area covered by wetland is about 220 sq. km. The wetlands water is used in agriculture fields to grow crops like rice, ragi, coconut, flowers and varieties of fruits and vegetables. It provides habitat to wild flora and fauna, including resident and migratory birds. But due to sewage and industrial wastewater wetland is damaged and this wastewater, not contaminant only the wetland but also pollutes the Pinakini river downstream and which decreases water quality. And directly influenced the economic significance of wetlands. (Ramachandra *et al.*, 2011)

(4) **East Kolkata Wetland:** Wetland is located in the eastern region of India. In the year 2002, EKW recognizes as a wetland ecosystem, it covered an area of about 127.41 km². This wetland faces the pressure of urban expansion. EKW cover the surrounding areas namely Rajarhat-Gopalpur, Bindhannagar and Sonarpur. EKW wetlands face an aerial shrinkage of 26% due to human activities, mainly urban encroachment. (Mondal *et al.*, 2017)

• **Case study in Gujarat:**

(1) **Chhaya Rann Wetland:** Chhaya rann wetland is a complex, narrow strip of brackish wetland habitat, spread about 2.25 km² and comprises Porbandar rann, Chhaya 1, Chhaya 2 and Chhaya 3 wetlands. Early it is also known as Birla rann where sea salt was produced. In recent years most of the wetland area covered the construction of housing societies, roads, shops and other infrastructure as part of the urban exploration of Porbandar. Due to the development of roads, wetlands are fragmented into small parts known as Porbandar bird sanctuary, Porbandar rann, Chhaya 1, Chhaya 2 and Chhaya 3. The Porbandar bird sanctuary is separated from the Chhaya wetlands, and water can flow between Chhaya 1, 2 and 3 and none of these are connected to the sea. Chhaya 3 is not available in summer and is managed as salt pans and it provides standing sites for waterbirds. (Vargiya & Chakraborty, 2019)

(2) **Gosabara Wetland:** Gosabara wetland located in the Porbandar district of Gujarat, is spread over 129 km². Gosabara wetland is a group of wetlands in the Porbandar district. Wetland is formed with Karli tidal regulators. It is the combination of the estuary and freshwater habitat. The main reason for to destruction of the wetland is evaporation due to climate change. The water spread area decreased without reducing the capacity. (Publication15-12-2017-1513309472.Pdf, n.d.)

Impact of Wetland Loss:

Wetland loss is a global phenomenon (Zedler & Kercher, 2005; Dudgeon *et al.*, 2006; Vörösmarty *et al.*, 2010) with major causes. The primary threats of wetland destruction are habitat loss, climate change, pollution, invasive species, overharvesting and disease. (R. T. Kingsford *et al.*, 2016)

Wetland provides goods and services that affect the economic importance of wetlands for residents who depend on this wetland. (Schuyt, 2005). When building dams to store water for agricultural purposes and diversify the flow of water, it sometimes turns wetland dries and that directly affects irrigation. (Lemly *et al.*, 2000); R. Kingsford, 2006).



Wetland loss does not only affect humans but as well as they affect animals and plant species. Due to urbanization living beings lose their habitat, and wetland pollution damage their growth of population, also urban expansion destructs the natural wetland and damages their wild floral and faunal diversity. wetland degradation also affects the atmosphere of the earth, pollution, damaging natural ecosystem and climate change.

In the 21st century development is most important for any economy and these uncontrolled and unplanned development break the chain of healthy ecosystems. These cause serious impacts on living and nonliving organisms.

The concrete infrastructure reduces green cover and these problems turn into increasing greenhouse gases in the atmosphere. As well as sewage and industrial wastewater polluted the pure water of wetlands and these impact human health, cause several diseases and also affect aquatic organisms. (R. T. Kingsford *et al.*, 2016)

CONCLUSION

This paper focuses on the importance of wetland ecosystems and how wetlands play a major role in the world's economy. But several human activities, harm these natural ecosystems. If we don't value the importance of natural resources, wetlands are further degraded. Evolution in any field gives more facilities and opportunities for humans. In past, some decades people were ignorant about protecting the earth's environment and which resulted in losing the natural ecosystem. Wetland degradation and loss is a major issue in the current situation. The case studies show the reality of resources, not only small water bodies but largest wetlands are fragmented or degraded due to exploration of human activities. Wetland degradation prevents several issues like pollution, climate change, loss of natural habitat, etc. and these problems directly affect the environment. To control the loss of wetlands, strict rules and regulations are needed and also Government should spread awareness. Government can also make special laws, organize management agencies, and built strong research and monitoring teams to conserve wetlands.

REFERENCES

- 1) Act, S. C. C. (2016). Ministry of Environment. *Japan* [https://Www. Env. Go. Jp/Water/Dojo/GL_ex-Me/Pdf/01_chpt1. Pdf \(in Japanese\). Accessed, 5](https://Www. Env. Go. Jp/Water/Dojo/GL_ex-Me/Pdf/01_chpt1. Pdf (in Japanese). Accessed, 5).
- 2) Aqsiq, S. A. C. (2007). *Common Portland Cement*. GB/175-2007, Beijing, China.
- 3) Assessment of environmental factors causing wetland degradation, using Fuzzy Analytic Network Process: A case study on Keoladeo National Park, India. (2015). *Ecological Modelling*, 316, 1–13. <https://doi.org/10.1016/j.ecolmodel.2015.07.029>
- 4) Bai, J., Cui, B., Cao, H., Li, A., & Zhang, B. (2013). Wetland Degradation and Ecological Restoration. *The Scientific World Journal*, 2013, 1–2. <https://doi.org/10.1155/2013/523632>
- 5) Barbier, E. B. (2007). Valuing ecosystem services as productive inputs. *Economic Policy*, 22(49), 178–229.
- 6) Bezabih, B., & Mosissa, T. (2017). Review on distribution, importance, threats and consequences of wetland degradation in Ethiopia. *International Journal of Water Resources and Environmental Engineering*, 9(3), 64–71. <https://doi.org/10.5897/IJWREE2016.0697>
- 7) Boyd, J., & Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics*, 63(2–3), 616–626.
- 8) Chen, M., Liu, W., & Lu, D. (2016). Challenges and the way forward in China's new-type urbanization. *Land Use Policy*, 55, 334–339.
- 9) Chen, Y., & Zhou, L.-A. (2007). The long-term health and economic consequences of the 1959–1961 famine in China. *Journal of Health Economics*, 26(4), 659–681.
- 10) Cong, L., Zhang, H., Zhai, J., Yan, G., Wu, Y., Wang, Y., Ma, W., Zhang, Z., & Chen, P. (2018). The blocking effect of atmospheric particles by forest and wetland at different air quality grades in Beijing China. *Environmental Technology*.
- 11) Council, N. R. (1995). *Wetlands: Characteristics and boundaries*. National Academies Press.
- 12) Daily, G. C. (1997). Introduction: What are ecosystem services. *Nature's Services: Societal Dependence on Natural Ecosystems*, 1(1).



- 13) Daily, G. C., Söderqvist, T., Aniyar, S., Arrow, K., Dasgupta, P., Ehrlich, P. R., Folke, C., Jansson, A., Jansson, B.-O., & Kautsky, N. (2000). The value of nature and the nature of value. *Science*, 289(5478), 395–396.
- 14) Das, A., & Basu, T. (2020). Assessment of peri-urban wetland ecological degradation through importance-performance analysis (IPA): A study on Chatra Wetland, India. *Ecological Indicators*, 114, 106274. <https://doi.org/10.1016/j.ecolind.2020.106274>
- 15) Development, W. B. C. for S., & Institute, W. R. (2001). *The greenhouse gas protocol: A corporate accounting and reporting standard*. World Resources Inst.
- 16) Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z.-I., Knowler, D. J., Lévêque, C., Naiman, R. J., Prieur-Richard, A.-H., Soto, D., & Stiassny, M. L. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews*, 81(2), 163–182.
- 17) Dutta, S., & Sengupta, A. (2015). Wetland restoration, a need for sustenance: A case study Chatra Beel of English bazar, district Malda, WB, India. *International Journal of Applied Research*, 1(8), 810–814.
- 18) Freeman III, A. M. (2003). Economic valuation: What and why. In *A primer on nonmarket valuation* (pp. 1–25). Springer.
- 19) Fu, C., Hua, X., Li, J., Chang, Z., Pu, Z., & Chen, J. (2006). Elevational patterns of frog species richness and endemic richness in the Hengduan Mountains, China: Geometric constraints, area and climate effects. *Ecography*, 29(6), 919–927.
- 20) Goodchild, M. F. (2013). The quality of big (geo) data. *Dialogues in Human Geography*, 3(3), 280–284.
- 21) Gupta, N., Mathew, A., & Khandelwal, S. (2019). Analysis of cooling effect of water bodies on land surface temperature in nearby region: A case study of Ahmedabad and Chandigarh cities in India. *The Egyptian Journal of Remote Sensing and Space Science*, 22(1), 81–93.
- 22) Kar, S. K. (2018). State of wetland transformation and ecological concerns—A case study of Chatra Wetland, English Bazar, West Bengal. *International Journal of Research in Geography*, 4(2), 1–8.
- 23) Kar, S. K., & Pal, S. (2012). Changing land use pattern in Chatra wetland of English Bazar Town: Rationale and flaws. *International Journal of Humanities and Social Sciences*, 2(2), 201–206.
- 24) Kingsford, R. (2006). *Ecology of desert rivers*. Cambridge University Press.
- 25) Kingsford, R. T., Basset, A., & Jackson, L. (2016). Wetlands: Conservation's poor cousins. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 26(5), 892–916. <https://doi.org/10.1002/aqc.2709>
- 26) Lemly, A. D., Kingsford, R. T., & Thompson, J. R. (2000). Irrigated agriculture and wildlife conservation: Conflict on a global scale. *Environmental Management*, 25(5), 485–512.
- 27) Mathur, V. B., Sivakumar, K., Singh, B., & Anoop, K. R. (2009). A bibliographical review for identifying research gap areas: Keoladeo Ghana National Park—A World Heritage site. *Wildlife Institute of India, Dehradun*, 54.
- 28) MEa, M. E. A. (2005). *Ecosystems and Human Well-Being: Wetlands and water synthesis*.
- 29) Melly, B. L., Schael, D. M., & Gama, P. T. (2017). Perched wetlands: An explanation to wetland formation in semi-arid areas. *Journal of Arid Environments*, 141, 34–39.
- 30) Meng, W., He, M., Hu, B., Mo, X., Li, H., Liu, B., & Wang, Z. (2017). Status of wetlands in China: A review of extent, degradation, issues and recommendations for improvement. *Ocean & Coastal Management*, 146, 50–59. <https://doi.org/10.1016/j.ocecoaman.2017.06.003>
- 31) Mondal, B., Dolui, G., Pramanik, M., Maity, S., Biswas, S. S., & Pal, R. (2017). Urban expansion and wetland shrinkage estimation using a GIS-based model in the East Kolkata Wetland, India. *Ecological Indicators*, 83, 62–73. <https://doi.org/10.1016/j.ecolind.2017.07.037>
- 32) Naiman, R. J., & Décamps, H. (1990). *The Ecology and Management of Aquatic-terrestrial Ecotones*. Taylor & Francis.
- 33) Pagiola, S., Von Ritter, K., & Bishop, J. (2004). *Assessing the economic value of ecosystem conservation*.
- 34) Pal, S., & Ziaul, S. K. (2017). Detection of land use and land cover change and land surface temperature in English Bazar urban centre. *The Egyptian Journal of Remote Sensing and Space Science*, 20(1), 125–145.



- 35) Perennou, C., & Ramesh, B. R. (1987). *Explanatory notes on the vegetation map of Keoladeo National Park (Bharatpur, Rajasthan)*. French Institute: the Bombay Natural History Society.
- 36) *Publication15-12-2017-1513309472.pdf*. (n.d.). Retrieved March 19, 2023, from <https://indo-germanbiodiversity.com/pdf/publication/publication15-12-2017-1513309472.pdf>
- 37) Ramachandra, T. V., Alakananda, B., Rani, A., & Khan, M. (2011). Ecological and socio-economic assessment of Varthur wetland, Bengaluru (India). *Journal of Environmental Science & Engineering*, 53, 101–108.
- 38) Schuyt, K. D. (2005). Economic consequences of wetland degradation for local populations in Africa. *Ecological Economics*, 53(2), 177–190. <https://doi.org/10.1016/j.ecolecon.2004.08.003>
- 39) Vargiya, D., & Chakraborty, A. (2019). The status of waterbird populations of Chhaya Rann Wetland Complex in Porbandar, Gujarat, India. *Journal of Threatened Taxa*, 11(10), 14268–14278. <https://doi.org/10.11609/jott.3466.11.10.14268-14278>
- 40) Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S. E., Sullivan, C. A., & Liermann, C. R. (2010). Global threats to human water security and river biodiversity. *Nature*, 467(7315), 555–561.
- 41) *Wetlands as natural assets*. (n.d.). Retrieved March 20, 2023, from <https://www.tandfonline.com/doi/epdf/10.1080/02626667.2011.629787?needAccess=true&role=button>
- 42) Xu, T., Weng, B., Yan, D., Wang, K., Li, X., Bi, W., Li, M., Cheng, X., & Liu, Y. (2019). Wetlands of International Importance: Status, Threats, and Future Protection. *International Journal of Environmental Research and Public Health*, 16(10), Article 10. <https://doi.org/10.3390/ijerph16101818>
- 43) Yang, W., Liu, Y., Ou, C., & Gabor, S. (2016). Examining water quality effects of riparian wetland loss and restoration scenarios in a southern Ontario watershed. *Journal of Environmental Management*, 174, 26–34.
- 44) Zedler, J. B., & Kercher, S. (2005). Wetland resources: Status, trends, ecosystem services, and restorability. *Annu. Rev. Environ. Resour.*, 30, 39–74.